Top Level Results of STS-81 Direct Work Content Analysis (1 of 6)

- Measured by cumulative maintenance task hours 'clock hours'
- Note:Some direct flt hardware processing for Orbiter landing & SRB recovery unavailable at same level of analytical detail

DESIGN DISCIPLINES

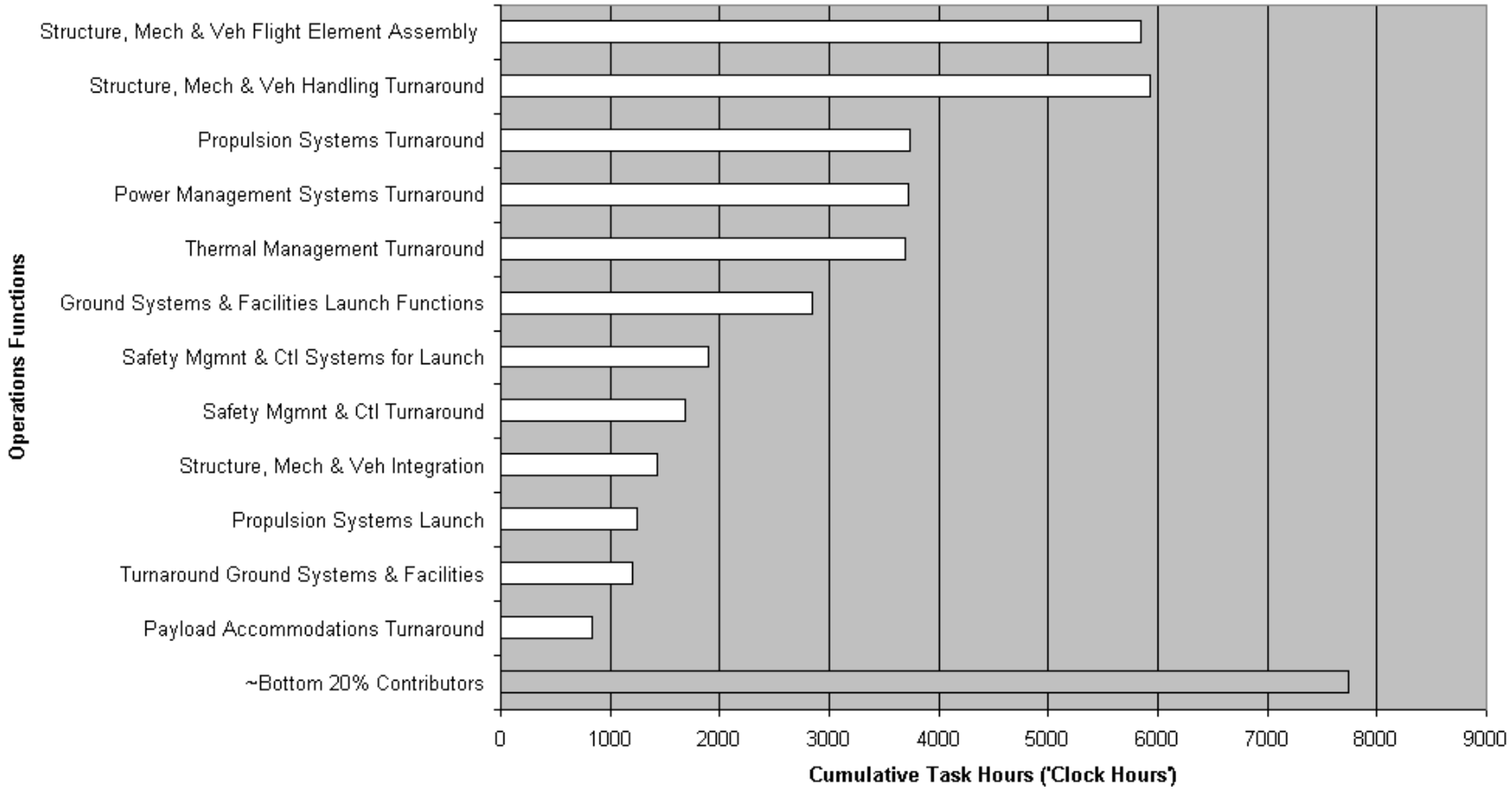
GENERIC OPERATIONS

MATRIX OF STS WORK CONTENT (As Measured by Cumulative Clock Hours of all planned/unplanned scheduled Tasks)	Structures, Mechanisms, Veh Handling (Including SRB)	Liquid Propulsion	Power Management (Mechanical and Electrical)	Thermal Management (Passive and Active)	Ground Systems & Facilities	Safety Management & Control (PVD + Monitor Orb Purges)	Payload Accommodations	Command, Control & Health Management (DPS, INS, SOF	Environmental Control & Life Support (ECL)	Communications	Cockpit & Crew Cabin (CCE, FCS)	Guidance, Navigation & Flight Controls	Totals	
GENERIC TURNAROUND FUNCTION	MEQ, PYR, STR, OHE, OPT, GSE, OSO, VPL, QC, SRM	MPS, OMS-RCS, SME, SRM, ETM	APU, HYD, FCP, EPD, OEL & SRB: SRE, GSP	TPS, TCS, ECL (Freon & water loops)	GSE	PVD, MPS & SME (safety purges)	PLO (CM, CE, TP)	DPS, INS, SOF	ECL	COM	CCE, FCS	GNC		
Turnaround	5934	3740	3721	3696	1197	1678	836	358	808	714	224	100	23006	55%
Launch	880	1249	452	128	2840	1897	558	400	108	0	48	28	8588	21%
Flight Element Assembly	5840	812	232	449	48	21	0	434	0	0	0	0	7836	19%
Vehicle Integration	1433	259	169	194	115	22	96	109	0	0	0	12	2409	6%
	14087	6060	4574	4467	4200	3618	1490	1301	916	714	272	140	41839	100%
	33.7%	14.5%	10.9%	10.7%	10.0%	8.6%	3.6%	3.1%	2.2%	1.7%	0.7%	0.3%	100.0%	

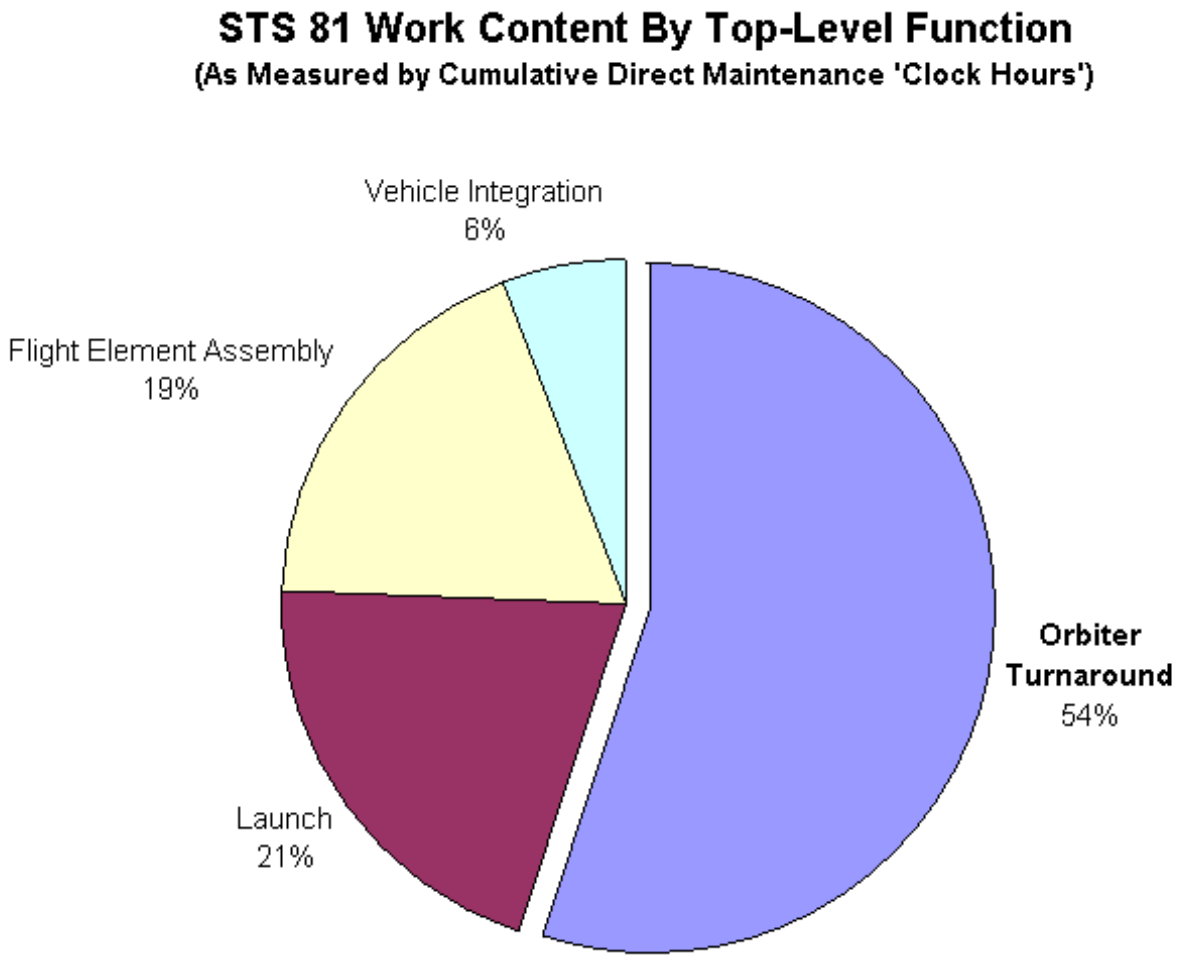
NGLT
NEXT GENERATION LAUNCH TECHNOLOGY

Top Level Results of STS-81
Direct Work Content Analysis (2 of 6)

- **Sorts largest contributing cells in previous chart (by ops function & design discipline)**



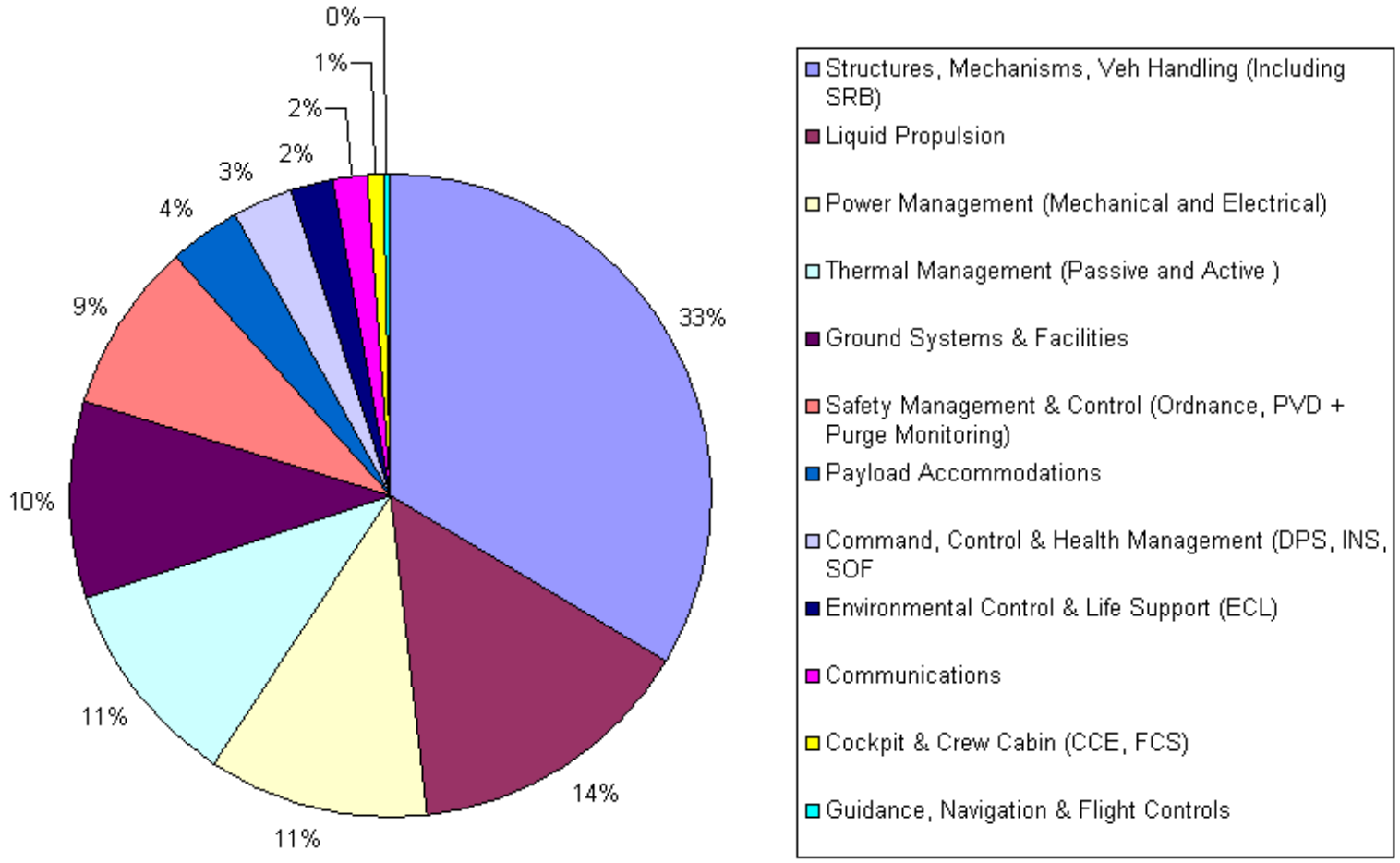
Top Level Results of STS-81
Direct Work Content Analysis (3 of 6)



Top Level Results of STS-81
Direct Work Content Analysis (4 of 6)

STS 81 Overall Work Content By Design Discipline

(As Measured by Cumulative Direct Maintenance 'Clock Hours')



Top Level Results of STS-81
Direct Work Content Analysis (5 of 6)

Generic Top-Level Operations

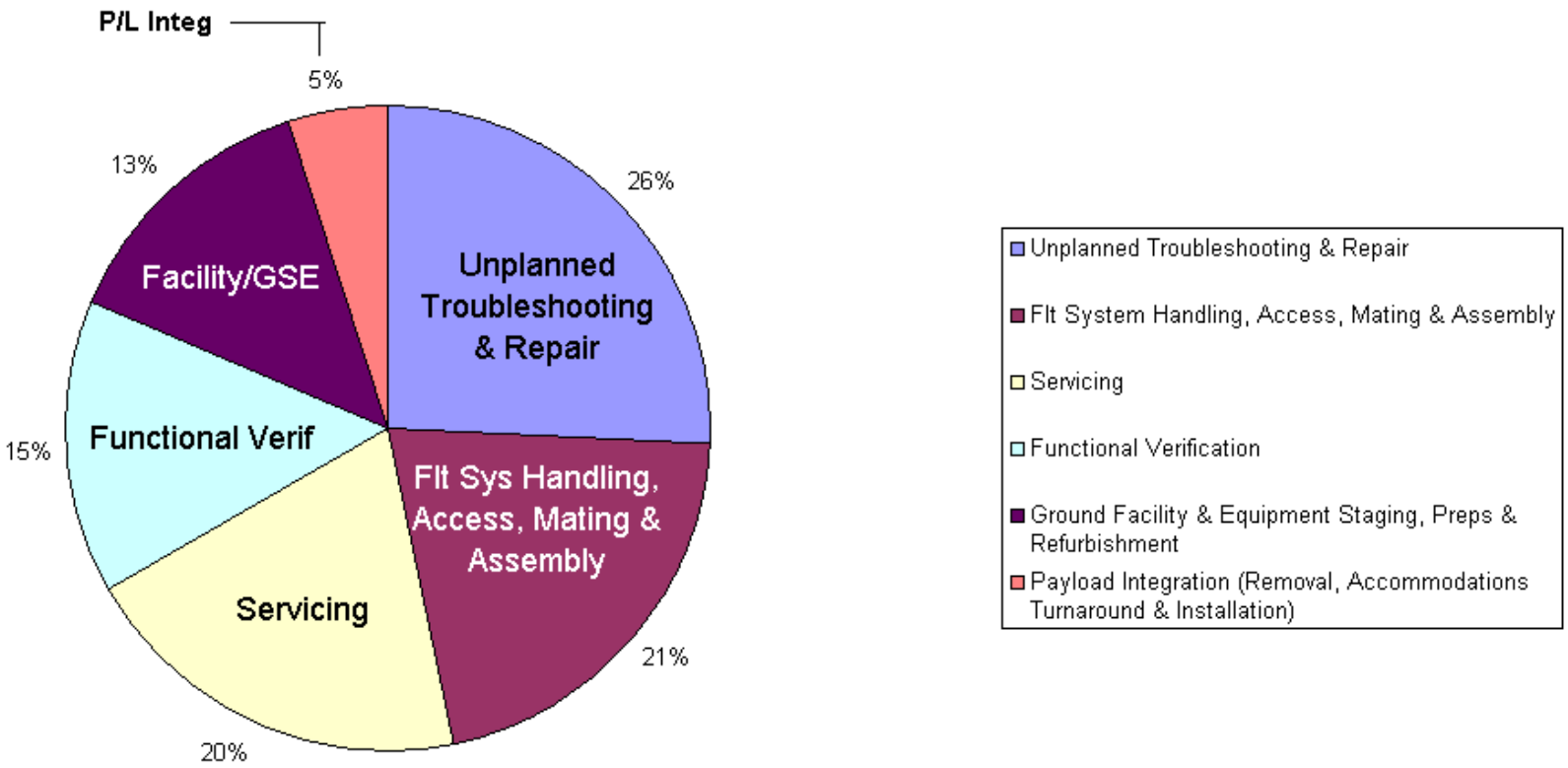
COMMON OPERATIONS FUNCTIONS

MATRIX OF STS WORK CONTENT (As Measured by Cumulative Clock Hours of all planned/unplanned scheduled Tasks)	TURNAROUND	LAUNCH	FLIGHT ELEMENT ASSEMBLY	VEHICLE INTEGRATION	Totals	
Unplanned Troubleshooting & Repair	5778	226	3215	743	9962	24%
Flt System Handling, Access, Mating & Assembly	2172	517	4265	1003	7957	19%
Servicing	5481	2095	0	142	7718	18%
Functional Verification	3512	1426	356	425	5719	14%
Ground Facility & Equipment Staging, Preps & Refurbishment	1210	3944			5154	12%
Payload Integration (Removal, Accommodations Turnaround & Installation)	1579	284		96	1959	5%
ALL OTHER	3274	96	0	0	3370	8%
T O T A L	23006	8588	7836	2409	41839	100%

Top Level Results of STS-81 Direct Work Content Analysis (6 of 6)

STS-81 Overall Direct Work Content By Common Functions

(As Measured by Cumulative Direct Maintenance Task Hours)



Review of Root Cause Results

Start with Common Operations Functions :

- **Excessive Unplanned Troubleshooting and Repair (~24%)**

  Preliminary Analysis of Design Root Causes:

  1. Flight & ground system dependability (i.e., design life and element reliability in relation to total parts count)
  2. Flight & ground system complexity manifested through high part counts in components, subsystems and redundancy management techniques
  3. Need to balance maintainability while achieving safety objectives (implement NSTS 5300.4/1D-2, Chapter 4 Maintainability Assurance items; i.e., effectively implement design corrective action and continuous improvement program)

- **Complex Assembly, Handling, Access, & Mating (~19%)**

  Preliminary Analysis of Design Root Causes:

  1. Number of launch site-installed subsystems and components per element
  2. Number and complexity of interfaces across assembled flight elements
  3. Number and frequency of reusable flight element modules and components requiring disassembly/re-assembly (SSME's OMS/RCS pods, RMS,etc.)
  4. Number of single use, limited life components, requiring assembly and access
  5. Decomposition of design discipline functions creates a non-integrated design process that duplicates and proliferates hardware without regard to recurring operations and infrastructure

Review of Root Cause Results

(Continued)

- **Excessive Requirements for Systems Servicing (18%)**
  Preliminary Analysis of Design Root Causes:
  1. Number and type of different fluid commodities requiring routine servicing and separate flight/ground interfaces
  2. Number of limited life items (relates to design life root cause)
  3. Decomposition of design discipline functions creates a non-integrated design process that duplicates and proliferates hardware without regard to recurring operations and infrastructure

- **Resulting Functional Verification (~14%)**
  Preliminary Analysis of Design Root Causes:
  1. Lack of demonstrated operational reliability (i.e., routine system operation without need for functional restoration between flights)
  2. Over-redundancy in design to overcome lack of demonstrated reliability
  3. Number of critical flight functions requiring functional verification
  4. Amount of reusable flight element disassembly and re-assembly, and amount of expendable flight item assembly resulting in the requirement for recertification prior to each flight commitment
  5. Amount of automation employed in the system (flight and ground elements)

Review of Root Cause Results

(Continued)

- **Excessive Facility & Equipment Refurbishment/Preps (~12%)**
  Preliminary Analysis of Design Root Causes:
  1. Ground system dependability (i.e., design life and hardware reliability in relation to total parts count)
  2. Lack of ground launch system design life to withstand the induced launch environment for frequent, routine launches
  3. Number of separate Ground Support Equipment items to support routine operations driven by flight systems design complexity
  4. Need to balance maintainability while achieving safety objectives (implement NSTS 5300.4/1D-2, Chapter 4 Maintainability Assurance items; i.e., effectively implement design corrective action and continuous improvement program)

- **Complex/Customized Payload Integration with Flight Element (5%--However, critical path impact is considered to be significant)**
  Preliminary Analysis of Design Root Causes:
  1. Unique vehicle payload accommodations customized for each flight during routine on-line operations--by design.
  2. Large number of flight-unique vehicle-provided services to the payload driving on-line operations (lack of payload cg and weight margin)